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PERFORMANCE OF RED SOKOTO BUCKS FED INCLUSION LEVELS OF IRRIGATED *CHAMAECRISTA ROTUNDIFOLIA* FORAGE MEAL IN THE NIGERIAN SAVANNA

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ABSTRACT

An experiment was conducted to investigate the growth performance of Red Sokoto bucks fed inclusion levels of irrigated *Chamaecrista rotundifolia* (CR) in Zaria. The experiment consisted of 12 Red Sokoto bucks of average initial weight range of between 8.56-10.38±0.1 kg, which were balanced for weight and randomly assigned to four dietary treatments containing varying inclusion levels of CR meal (0, 25, 50 and 75%). The bucks were individually pen-fed with the experiment diets at 3% body weight with three bucks per treatment in a Complete Randomize Design for a period of 90 days. Results indicated that bucks fed control diet gained statistically lower (P<0.05) average daily weight gain (11.00 g/day) compared with 75% CR inclusion level (31.67 g/day). However, voluntary feed intake was significantly higher (P<0.05) in the control diet (376.10 g/day) compared to with 75% CR inclusion level (247.25 g/day). Feed conversion ratio was lower (P<0.05) in bucks fed diet with 75% CR inclusion level (7.81) compared to the control (34.19). The digestibility coefficients of dry matter, crude protein, crude fibre, ether extract and nitrogen free extract were significantly higher (P<0.05) in bucks fed diet containing 75% CR inclusion level compared to the control diet. Similarly, bucks fed diets containing 75% CR had significantly (P<0.05) higher numerical values of nitrogen retention (2.42g/day) compared to the control (1.94g/day). It was hence, concluded that, farmers under smallholder production system could include CR meal up to 75% in the diet of Red Sokoto bucks for optimum growth performance.

Keywords: *Chamaecrista*, Bucks, Inclusion, Performance.

INTRODUCTION

Among the constraints facing livestock development, inadequate feed supplies stand out as one of the most important limiting factor in livestock production (Aregawi *et al.*, 2013). However, abundant crop residues, which are of poor quality and cannot meet the animal requirement in terms of minerals, vitamins and protein are often free feed for ruminants (Amodu *et al*., 2008). There is a clear need for alternative and cheaper means of supplementing the year round feed and nutrient shortfall for livestock especially in the dry season to improve productivity (Ademosum *et al*., 1985). Improvement in ruminant production will therefore require the identification of possible ways and means of upgrading poor roughages through increasing their digestibility and voluntary intake (Fadel Elseed, 2004). Forage crops, especially legumes, are needed to improve the utilization of crop residues by proper supplementation (Poppi and McLennan, 1992).

Round-leaf cassia (*Chamaecrista rotundifolia*) is one of such forage legumes that can be used to improve the poor quality crop residues. The dry forage yield of 2.84 t/ha, crude protein (14-20%) and Phophorus (0.30-0.50%) of *C.*

rotundifolia forage irrigated at 6 days interval, suggests that the legume is of high yield and nutritional quality (Bala, 2016b; Bala 2016c). In Nigeria, the major challenge for the smallholder farmer is poor quality livestock feeds (Franke *et al.,* 2011) especially in during the dry season, which could be addressed through irrigated forage production. The objectives of the study was to determine the growth performance, nutrient digestibility and nitrogen balance in Red Sokoto bucks fed varying levels of *C. rotundifolia* forage meal.

MATERIALS AND METHOD

Experimental Site

The feeding trial and nutrient digestibility study was conducted at the Animal Science Department, Teaching and Research Farm, Faculty of Agriculture, Ahmadu Bello University, Zaria, Kaduna State. The farm is located at an elevation of 676m and latitude of 11.2^0 North and longitude of 007.6^0 East (Ovimaps, 2014).

Experimental design and animal's management

Twelve (12) experimental Red Sokoto bucks of average initial weight range of between 8.56-10.38±0.1 kg were used. The animals were purchased from Giwa market and were balanced for initial weights before they were allocated to four treatments diets with three bucks per treatment in a Complete Randomize Design (CRD). After arrival from Giwa market, the bucks were de-wormed with Albendazole against internal parasites and were allowed 14 days to adjust to feed and confinement before the actual start of the experiment.

Experimental feeds and feeding trial

Four dietary treatments containing varying levels of *Chamaecrista rotundifolia* meal (0, 25, 50 and 75% inclusion) in the diet to containing 12% crude protein were used for the experiment (Table 2). The bucks were randomly allotted to 4 treatment diets with 3 bucks per treatment. The bucks were fed individually once in the morning (8.000am) at 3% body weight. Water and mineral salt lick were provided *ad libitum* for the period of 90 days.

Table 1: Ingredient composition of the experimental diets

	Percentage inclusion levels of *C. rotundifolia* meal			
Feed components (kg)	0	**25**	**50**	**75**
C. rotundifolia	0.0	5.5	9.6	12.7
Cotton seed cake	22.0	16.5	12.4	9.3
Maize offal	40.0	40.0	40.0	40.0
Rice offal	36.0	36.0	36.0	36.0
Bone meal	1.5	1.5	1.5	1.5
Common salt	0.5	0.5	0.5	0.5
Total	100.0	100.0	100.0	100.0
Calculated analysis				
Cost/kg feed (N)	38.12	33.41	28.66	28.91
ME(Kcal/kg)	3344	3314	3289	3301
Crude Protein (%)	12.86	12.51	11.95	12.79

CSC = cotton seed cake M.E = Metabolisable Energy N = Naira

Measurement of growth performance

Weekly feed intake, weight gain and feed conversion ratio were determined. Feed intake was obtained by the difference between supplied feed and feed left in each pen. Weight gain was determined as the difference between the weight of the animal at the beginning of the experiment and subsequently at two weekly intervals, respectively. Feed conversion ratio was obtained as the ratio of feed intake and weight gain within each week for each pen.

Digestibility and Nitrogen retention study

At the end of the feeding trial, two animals were randomly selected from each of the four treatment groups and housed in metabolic creates for total faecal and urine collection as described by Osuji *et al.* (1993). The bucks were maintained on the same treatment diets used in the feeding trial. Each morning (8.000am), feed left over, faecal output and urine output were collected and weighed for 7days. The daily total faecal output collected from each buck was weighed, bulked and sub-sampled for analysis. The daily urine output from each buck was collected into a plastic container containing 10ml of 0.1M H_2SO_4 to prevent nitrogen loss by volatilization which was placed under the metabolic creates. Urine collected was bulked and about 10% of the total urine output was sub sampled for each buck and stored in the refrigerator (1 - 20^0C) pending nitrogen determination.

Chemical analysis

Feed samples offered, feed left over and feacal output were analysed for chemical components at the Biochemistry Laboratory of the Animal Science Department, Ahmadu Bello University, Zaria while Urine nitrogen was analysed using Kjeldahl Procedure using the method described by A.O.A.C (2005). Metabolizable Energy (ME) of the diet was estimated using the equation of Alderman (1985):

ME (MJ/kg DM) = 11.78 + 0.00654CP + $(0.000665EE)^2$ – CF (0.00414EE) - 0.0118A

Where: A = Ash content, CP = Crude Protein, EE = Ether extract, CF = Crude fibre.

Statistical analysis

Data collected were analyzed using Analysis of Variance (ANOVA) by General Linear Model (GLM), procedure of Statistical Analysis System (SAS) version 9 (SAS, 2003). The treatment means were separated using Dunnet's Test. The following model was used:

$X_{ij} = \mu + \alpha_i + e_{ij}$

Where X_{ijk} = Any observation

μ = Population mean

α_i = Treatment effect

e_{ijk} = Random error

RESULTS

Chemical composition of the experimental diets

Table 2 showed the chemical composition of the diets used in the experiment. The highest value of crude fibre (18.01) was observed in treatment with 75% *Chamaecrista rotundifolia* (CR) while the treatment with 0% CR had the least (16.63). However, the NFE content ranged from 61.01% in treatment (25% CR) to 66.06% in treatment (0% CR). The NDF content of the experimental diet ranged from 43.84 in treatment with 50% CR to 45.66 in treatment (75% CR).

Table 2: Chemical composition of the diet containing various inclusion levels of *C. rotundifolia* meal complete diets

	Percentage inclusion of *C. rotundifolia*			
Parameters	**0**	**25**	**50**	**75**
Dry matter	93.36	92.88	93.12	93.48
Crude protein	13.08	12.86	12.42	12.97
Ether extract	4.67	4.25	4.01	4.68
Crude fibre	16.63	17.50	17.98	18.01
Nitrogen free extract	66.06	61.01	61.42	62.33
Ash	5.56	4.38	4.17	4.00
NDF	44.82	45.01	43.84	45.66
ADF	18.41	17.86	18.05	16.99

NDF = Neutral detergent fibre ADF = Acid detergent fibre

Performance of Red Sokoto bucks fed inclusion levels of *Chamaecrista rotundifolia* meal.

The result presented in table 3 showed the effect of varying inclusion levels of *Chamaecrista rotundifolia* (CR) meal on the performance of Red Sokoto Bucks. The final boy weight changes differed significantly (P<0.05) across the treatments. Treatments diets with 50 and 75% CR inclusion levels resulted in significantly higher (P<0.05) weight gain (2.51 and 2.85 kg) respectively, compared to the control (0.99 kg). Bucks fed control diet gained statistically lower (P<0.05) daily weight gain (11.00 g/day) compared with 75% CR inclusion level (31.67 g/day). Voluntary feed intake was significantly higher (P<0.05) in the control diet (376.10 g/day) compared to with 75% CR inclusion level (247.25 g/day). However, the feed conversion ratio was lower (P<0.05) with 75% CR inclusion level (7.81) compared to the control (34.19).

Table 3: Effect of varying inclusion levels of *C. rotundifolia* meal on the performance in Red Sokoto bucks

	Percentage inclusion of *C. rotundifolia*					
Parameters	**0**	**25**	**50**	**75**	**SEM**	**LOS**
Initial weight (kg)	9.79	10.00	8.11	8.10	1.59	NS
Final weight (kg)	10.78^{b}	11.74^{a}	10.61^{b}	10.95^{b}	0.14	*
Total weight gain (kg)	0.99^{c}	1.74^{bc}	2.51^{ab}	2.85^{a}	0.71	*
Average daily weight gain (g)	11.00^{d}	19.33^{c}	27.89^{b}	31.67^{a}	1.35	*
Daily feed intake (g)	376.10^{a}	354.71^{a}	256.18^{b}	247.25^{b}	4.25	*
Feed conversion ratio	34.19^{c}	18.35^{b}	9.19^{a}	7.81^{a}	0.84	*

^{abc} Means with different superscripts along the row differed significantly (P < 0.05)
SEM = Standard Error of Mean LOS = Level of Significance.

Nutrient digestibility of Red Sokoto bucks fed different inclusion levels of *Chamaecrista rotundifolia* meal.

Table 4 showed the result of nutrient digestibility study. There were significant differences (P<0.05) across the treatments in the entire digestibility coefficient. The result shows that the digestibilities of dry matter, crude protein, crude fibre, ether extract and nitrogen free extract were significantly higher (p<0.05) in bucks fed diet containing 75% *Chamaecrista rotundifolia* (CR) inclusion level compared to the control diet. Bucks fed 25% CR inclusion level had the highest percentage (P<0.05) digestibility of Ash. Also, the result indicated that the digestibility coefficient of nitrogen free extract was significantly higher (P<0.05) in the diet containing 75% CR inclusion level compared to the control.

Table 4: Effect of varying inclusion levels of *C. rotundifolia* meal on nutrient digestibility in Red Sokoto bucks

	Percentage inclusion of *C. rotundifolia*					
Nutrient Digestibility	**0**	**25**	**50**	**75**	**SEM**	**LOS**
Dry matter	60.00^{b}	63.63^{b}	62.21^{b}	78.27^{a}	1.86	*
Crude protein	69.38^{c}	75.55^{b}	74.19^{b}	86.21^{a}	1.07	*
Crude fibre	65.32^{c}	76.80^{b}	76.30^{b}	85.45^{a}	1.14	*
Ether extract	80.28^{b}	82.66^{b}	82.15^{b}	86.66^{a}	1.10	*
Ash	43.20^{b}	46.90^{a}	39.81^{c}	37.95^{d}	0.89	*
Nitrogen free extract	41.13^{d}	50.11^{b}	47.13^{c}	72.96^{a}	1.13	*

^{abc} Means with different superscripts along the row differed significantly (P < 0.05)
SEM = Standard Error of Mean LOS = Level of Significance

Nitrogen retention of Red Sokoto bucks fed inclusion levels of *C. rotundifolia* meal.

Table 5 showed the result of nitrogen balance. There was significant (P<0.05) differences in all parameters measured. Nitrogen intake significantly decreased (P<0.05) with increasing levels of *Chamaecrista rotundifolia* (CR) inclusion in the diet. The result of the urinary N significantly increasesd (P<0.05) across the treatments as the inclusion level increased. Bucks fed diets containing 75% CR had significantly (P<0.05) higher numerical values of nitrogen retained (2.42g/day) and absorbed (4.30g/day), respectively.

Table 5: Effect of varying inclusion levels of *C. rotundifolia* meal on Nitrogen balance in Red Sokoto bucks

	Percentage inclusion of *C. rotundifolia*					
Nitrogen balance (g/day)	**0**	**25**	**50**	**75**	**SEM**	**LOS**
Nitrogen intake	7.34[a]	7.09[a]	5.12[b]	4.95[b]	0.58	*
Faecal Nitrogen	4.14[a]	3.90[a]	1.10[b]	0.65[b]	0.63	*
Urinary Nitrogen	1.26[c]	1.35[bc]	1.66[ab]	1.88[a]	0.41	*
Total Nitrogen Loss	5.40[a]	5.25[a]	2.76[b]	2.53[b]	0.49	*
Nitrogen retained	1.94[b]	1.84[b]	2.36[a]	2.42[a]	0.37	*
Nitrogen retained (%N-intake)	26.43[c]	25.95[c]	46.09[b]	48.88[a]	0.78	*
Nitrogen absorbed	3.19[b]	3.19[b]	4.02[a]	4.30[a]	0.52	*

[abc] Means with different superscripts along the row differed significantly ($P < 0.05$)
SEM = Standard Error of Mean LOS = Level of Significance

DISCUSSION

Bucks fed inclusion levels gained more weight on daily basis compared to the control treatment. Weight gain increases as the level of *Chamaecrista rotundifolia* (CR) meal increases in the diets. This can be explained by the fact that CR meal might have helped to increase the efficiency of utilization of roughages by the rumen microbes which lead to improve weight gain in mature animals (Karikari and Blasu, 2009). Feed intake was relatively low at higher inclusion levels of CR meal but where digestibility of dry matter was higher. This is evidenced in the low feed conversion ratio observed in all treatment containing CR meal compared to the control. The result of this study indicated that the inclusion of improved leguminous forages in diets of ruminant livestock help to improve intake, digestibility and nutrient status of the diet, thereby improving overall performance (Abule *et al.*, 2005). In this study however, the optimum level of performance of red Sokoto bucks was not fully exploited even at 75% CR inclusion level. This might be related to the low level of cotton seed cake in the diets due to replacement by the CR meal. The digestibility of dry matter (DM), crude protein, crude fibre and ether extract were found to increase with increasing levels of CR meal inclusion in the diet. The most probable explanation for this phenomenon is in the fact that diet at 75% inclusion level contained higher percentage of CR meal which might result in high palatability and better utilization of the nutrients by bucks. Also, it may be attributed to the quality of CR meal which might have increased the activity of rumen microorganisms for rapid fibre digestion in the rumen (Bala, 2016a).

The increase in nitrogen intake may be as a result of inclusion level of CR meal. The significant high urinary N observed across treatments up to the highest inclusion level (75% CR) can be explained by the fact that the excess ruminal ammonia was absorbed and excreted in the urine in the form of urea (Murphy and Colucci, 1999). The nitrogen (N) retention recorded in bucks fed higher inclusion levels is in agreement with the report of Yashim, (2016) that nitrogen depends on good digestibility of nutrients and or utilization. Nitrogen retention is the major indicator for

accessing the protein nutritional status of ruminant livestock (Abdu *et al.,* 2012). Also, the nitrogen absorbed was numerically higher in bucks fed diets with 75% (4.30 g/day) CR inclusion level compared to the control (3.19 g/day). This might be related to the high feacal N losses in the control diet compared with 75% CR inclusion level. In the study, the significantly higher nitrogen balance in bucks fed inclusion levels of CR meal indicated that it contained enough protein and digestible nutrients to provide protein retention for better performance in Red Sokoto bucks.

CONCLUSION

From the result obtained from the trial, it was concluded that farmers could include *Chamaecrista rotundifolia* meal up to 75% in the diet of Red Sokoto bucks for optimum performance and profit gain without any detrimental effect on the performance of the animals under smallholder production system.

REFERENCES

Abdu, S. B., Ehoche, O. W., Adamu, A. M., Bawa, G. S., Hassan, M. R., Yashim, S. M. and Adamu, H. Y. (2012). Effect of Varying Levels of Zizyphus (*Zizyphus mauritiiana*) Leaf Meal Inclusion in Concentrate Diet on Performance of Growing Yankasa Ram lambs Fed Maize Stover Basal Diet. Iranian *Journal of Applied Animal Science* 2 (4): 253-256.

Abule, E., Temsegen, T. and Tekele, A. (2005). The supplementation of haricot bean residue with lablab (*Lablab purpureus*) hay in the diet of Arsi bulls and heifers (*Bos indicus*). Tropical Science 45 (3): 114-117.

Ademosum, A. A., Jansen, H. G. and van Houter, V. (1985). Goat management research at the University of Ife. In; Sheep and Goat in Humid West Africa (Eds) . Sumberg J. E. and Cassady, K. ILCA,Addis Ababa, Ethiopia. Pp 32-41.

Alderman, G. (1985). Prediction of the energy value of compounds feed. In: W. Haresign and D.J. Cole (eds). *Recent Advances In Animal nutrition*. Butterworths, London, U.K. 19.

Amodu, J. T. and Kalla, M. S. (2008). A Guide to Hay Making. Extension Guide published by the National Animal Production Research Institute, Shika Zaria. 3pp.

AOAC, (2005). Official Methods of Analysis of Association of Official Analytical Chemist, 17th Edition, Washington D. C., U. S. A.

Aregawi, T., Animut, G. and Kassa, H. (2013). Utilization and nutritive value of sesame (*Sesamum indicum* L.) straw as feed for livestock in the North western lowlands of Ethiopia. *Livestock Research for Rural Development. (25),124.*

Bala, A. G. (2016a). *Productivity and quality of round-leaf cassia (Chamaecrista Rotundifolia Cv Wynn) under flood irrigation for smallholder livestock farmers in Nigerian Savannah.* An M.Sc. Dissertation Submitted to the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria. 75pp.

Bala, A. G., Hassan, M. R., Amodu, J. T., Tanko, R. J., Bello, S. S., Abdu, S. B., Ibrahim, U. B., Ishiaku, Y. M. and Ibrahim, H. (2016b). Growth components and forage yield of Wynn Cassia (Chamaecrista rotundifolia Cv. Wynn) as influenced by varying levels of irrigation volume, frequency and Natron (Kanwa) in the Nigerian Savanna. *Journal of Animal Production Research* 28(1): 254-262.

Bala, A. G., Hassan, M. R., Tanko, R. J., Abdu, S. B., Hassan A. H., Bello, S. S., Ibrahim, U. B., Ishiaku, Y. M., Ibrahim, H., Ahmed, S. A. and Abdullahi, U (2016c). Effect of irrigation volume, frequency and natron (Kanwa) on chemical composition of round-leaf cassia (*Chamaecrista rotundifolia cv. Wynn*) in Nigerian savanna. *Gashua Journal of Irrigation and Desertification Studies, Gashua*. 1 (2): 62-67.

Fadel Elseed, A. M. A. (2004). Effect of supplemental protein feeding on ruminal characteristics and microbial N production in sheep fed treated rice straw. *Small Ruminants Research*, Elsevier 57 (2005): pp 11-17.

Franke, A. C., Rufino, M. C. and Farrow, A. (2011). Characterization of the impact zones and mandate areas in the N2Africa Project. Milestone reference number 1.4.1, 50pp.

Karikari, P. K. and Blasu, E. Y. (2009). Influence of nutritional flushing prior to mating on the performance of West African Dwarf Goats mated in the rainy season. *Livestock Research for Rural Development*.21 (103).Retrieved January 15, 2013, from http://www.Irrd.org/Irrd21/7/kari21103.htm

Murphy and Colucci, P. E. (1999). A tropical forage solution to poor quality ruminant diets: A review of *Lablab purpureus*. *Livestock Research for Rural Development* (11) 2 1999. http://www.cipav.org.co?Irrd11/2/colu.htm

Osuji, P. U., Nsahli, I. V. and Khalil, H. (1993). *Feed evaluation*. ILCA manual 5 : ILCA, Addis Ababa Ethiopia. 40.

Ovimaps, (2014). Ovilocation map;ovi earth imaginary date, February, 2014.

Poppi, D. P. and McLennan, S. R. (1992). Native value of horsegram, digestibility and protein. *The journal of Agricultural research and biodiversity Research*, ISSN. Pp 167-177.

SAS, (2003) .SAS/STAT. Guide for personal computer version, 6th Edition. Statistical Analysis System Institute, Inc. Cary, North Carolina, USA.

Tarawali, S. A. (1991). Preliminary agronomic evaluation of forage legumes for subhumid West Africa. *Tropical Agriculture (Trinidad)* 68: 88-94

Yashim, S., Gadzama, U. I. and Fwangtu, P. I. (2016). Comparative evaluation of nutritive value of cowpea (*Vigna unguiculata*) and groundnut (*Arachis hypogaea*) haulms in the diet of Red Sokoto goats. *Adamawa State University Journal of Agricultural Science*. 4(2):134-144.